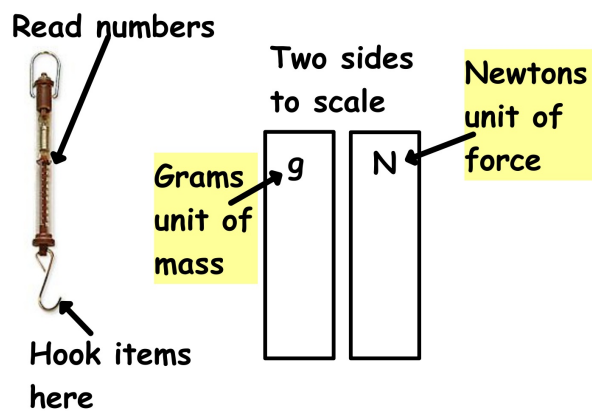


## Forces and Motion

- 3.1 Force, Mass and Acceleration
- 3.2 Weight, Gravity and Friction
- 3.3 Equilibrium, Action and Reaction

### What is force?

#### How to read the spring scale



- A **force** is what we call a *push or a pull*, or any *action that has the ability to change motion*.
- There are two units of force that are commonly used: **pounds** and **newtons**.
- Scientists prefer to use newtons.

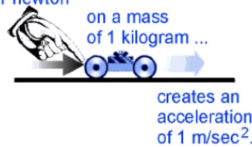
Unit	Equivalents
1 newton	0.228 pounds
1 pound	4.48 newtons

- Force and mass have different units.
- The metric unit of force, the **newton**, relates force and motion.

#### Newton

A newton is the metric unit of force.

A force of 1 newton



### Lab 3.1 Manual p 16

#### Need

- car,
- 3 weights,
- spring scale,
- ramp set to #5

- **Mass** is the amount of “stuff” or matter in an object.
- We can also define mass as the amount of matter an object has.
- Mass is measured in **kilograms**.

Bunch of bananas  
1 kilogram



Cat  
5 kilograms

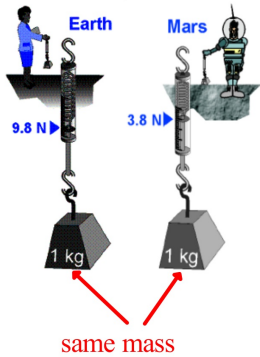


Person  
55 kilograms



- Because **mass** is an amount of matter, mass is independent of the force of gravity.
- **The mass of an object is the same everywhere in the universe.** The only exception to this rule is when things go extremely fast, close to the speed of light.

### 3.1 The difference between weight and mass



- **Weight** is a force that comes from gravity pulling on mass.
- The weight depends on how strong gravity is.
- Earth is bigger than Mars and has stronger gravity.
- A kilogram weighs 9.8 newtons on Earth but only 3.8 newtons on Mars.

### 3.1 Sir Isaac Newton's laws of motion

- **Sir Isaac Newton** (1642-1727), an English physicist and mathematician, is one of the most brilliant scientists in history.
- Before the age of 30, he formulated the basic laws of mechanics, discovered the universal law of gravitation, and invented calculus!



[Read Article](#)

#### The Three Laws

#### What Each One Says

##### Newton's first law of motion

An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion will continue with constant speed and direction, unless acted on by an unbalanced force.

##### Newton's second law of motion

The acceleration of an object is directly proportional to the force acting on it and inversely proportional to its mass.

##### Newton's third law of motion

Whenever one object exerts a force on another, the second object exerts an equal and opposite force on the first.

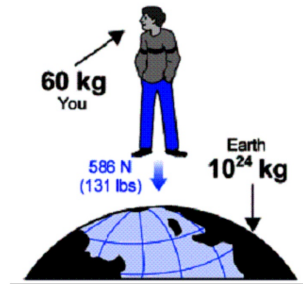
[See other chart on Newton's Laws](#)

### 3.2 Gravity (SchoolHouse Rock Video)

- The attractive force from gravity between objects of ordinary mass is incredibly small.



- You feel weight because the mass of Earth is large enough to create significant gravity forces.



## Newton's Law of Universal Gravitation

- The force of attraction between two objects is directly related to the masses of the objects and inversely related to the square of the distance between them.

